

# Research - Wildlife Restoration

## Disclaimer

This project statement is meant to be used as a training aid. While some of the information provided in the project statement is based upon factual data, the entire project statement is not meant to represent an actual project statement drafted by Montana Fish, Wildlife, and Parks.

## MT – Montana Shiras Moose Study

### Need

There is a need for the Montana Fish, Wildlife and Parks (MFWP) to effectively manage and conserve moose populations to continue to meet the expectations of the state's diverse hunters and wildlife-viewers, as well as maintain viability of the species within the state. The distribution and population dynamics of moose (*Alces alces*) in North America have remained dynamic since the species' arrival on the continent 11,000-14,000 years ago (Hundertmark and Bowyer 2004). Moose populations at the southern range extent have generally increased in modern times (Karns 2007), including the colonization of the Rocky Mountain states of the western US in the past 200 years (Peek and Morris 1998) and the recolonization of historic range in the eastern US in the past 30 years (Wattles and DeStefano 2011). However, in the past decade concern for the viability of southern moose has also arisen in local populations such as those of Minnesota (Murray et al. 2006, Lenarz et al. 2010), northeast North Dakota, northwest Wyoming (Becker 2008), Nova Scotia (Pulsifer and Nette 1995), and Montana (DeCesare et al. 2014).

The Shiras moose (*A. a. shirasi*) is the southernmost subspecies of moose in North America, with a current range extending south from southern Alberta and British Columbia into Washington, Oregon, Idaho, Montana, Utah, Wyoming, and Colorado (Peek and Morris 1998, Matthews 2012). Moose in Montana have undergone a general population increase since the early 1800's, though concern has risen over potential moose declines during the early 21st century (Smucker et al. 2011). Annual harvest in Montana peaked in 1994 at 656 animals, when 89% of permitted hunters were successful and spent an average of 8.7 days hunting per successful kill. Since the late 1990's both the number of permits issued and moose harvested have dropped, hunter success rates have decreased and days per harvest have increased. For example, the 2009 harvest was the lowest recorded since 1957, with 359 moose harvested, a hunter success rate of 73%, and an average of 14.4 hunter-days per harvest.

In Montana, beyond hunter harvest statistics, available data concerning moose dynamics are fairly inconsistent, including hunter and landowner sighting data and various forms of aerial surveys across a small subset of hunting districts. Furthermore, knowledge of the external factors most important in driving moose dynamics is fairly incomplete. Elsewhere, researchers have shown a wide host of possible factors limiting moose populations, including climate-related factors such as heat stress and winter snow depth (Mech et al. 1987, Solberg et al. 1999, Lenarz et al. 2009), parasites including the meningeal worm (*Parelaphostrongylus tenuis*; Lankester 2010), arterial worm (*Elaeophora schneideri*; Henningsen et al. 2012), winter ticks (*Dermacentor albipictus*; Samuel 2004, Vucetich and Peterson 2009), and giant liver fluke (*Fascioloides magna*; Murray et al. 2006), predation by wolves (*Canis lupus*), grizzly bears (*Ursus arctos*) and black bears (*Ursus americanus*; Boutin 1992, Gasaway et al. 1992, Hayes et al. 2000, Bertram and Vivion 2002, Vucetich and Peterson 2009), forage quantity or quality (Franzmann and Schwartz 1985, McArt et al. 2009), and human harvest (Bergerud et al. 1968, Fryxell et al. 1988, Solberg et al. 1999, Brown 2011). It also seems clear that these factors have interacting effects (Vucetich and Peterson 2009, Brown 2011), further complicating interpretation of current dynamics in Montana.

Suspected moose declines in Montana may be driven by several of the above mentioned factors. In a recent expert opinion survey of 22 MFWP management biologists, factors of concern included predation (64%), hunter harvest (41%), habitat succession (41 %), parasites and disease (36%), and several other factors of concern (T. Smucker, MFWP, unpublished data). In Montana, moose are within the southern range extent, and thus may be particularly susceptible to heat stress with warming climates. While the meningeal worm has not been detected in Montana, preliminary sampling has shown relatively widespread prevalence of arterial worms (Ramsey 2011), liver flukes (Knapp et al. 1992), and winter ticks (Bishopp and Trembley 1945). Montana is also host to stable or increasing predator populations of wolves (Gude et al. 2012), grizzly bears (Kendall et al. 2009, Mace et al. 2012), and black bears (Beston and Mace 2012). The role of forage availability or quality may be particularly relevant in northwest Montana, where much of the logging-created early-seral habitat favored by moose has aged beyond the optimum window for moose diet (e.g., Kelsall et al. 1977, Schwartz and Franzmann 1989). Finally, hunter harvest has been implicated for moose declines in Montana in the past (Schladweiler 1974), and has also been included as an objective for population control during the last 15 years in some areas where crop depredation pressure is high (V. Boccadori, MFWP, personal communication).

While moose are consistently associated with shrub and early-seral forest habitats across their circumpolar range, occupied habitats within Montana are diverse. Forestry practices have been associated with range expansion of moose into closed forest habitats such as those of northwest Montana (Matchett 1985) and southern British Columbia (Bergerud and Elliot 1986, Serrouya et al. 2011). Here early-seral shrub and regenerating forest habitats are the result of logging cutblocks, and have resulted in abundant moose populations. To the contrary, moose habitat in southwest Montana is typically characterized by dense, linear patches of willow along riparian corridors, where snow conditions in late winter can cause shifts to closed canopy forests (Peek 1971) or reduction in home ranges sizes (Burkholder 2012). This variation in habitat may be indicative of variation in limiting factors across moose distribution in Montana as well.

Given these uncertainties, the current status of moose, factors limiting population growth, and methods for population status monitoring have all been recently prioritized as key research areas for wildlife managers across the state of Montana. Information regarding baseline survival and recruitment rates, as well as which external factors are most predictive of them, would provide managers valuable information for assessing trend, viability, and harvest prescriptions for moose across the state. Additionally, a cost-effectiveness assessment of monitoring techniques is needed within Montana to ensure maximum knowledge gain from monitoring expenditures as well as coordination of data collection among hunting districts. Herein we describe the objectives, approaches, and expected results and benefits for a 5-year moose research and monitoring project developed to increase the rigor of moose knowledge and management within the state of Montana. Without this information, it will become increasingly more difficult for MFWP to effectively manage and conserve the state's moose resources.

### Purpose

The purpose of this grant is to conduct a 5-year research project on Montana's Shiras moose population in order to improve MFWP's management of the resource.

## Objective

Conduct 1 study by June 30, 2021. (*NOTE: TRACS strategy - Data Collection & Analysis*)

## Results and Benefits Expected

This grant will benefit the moose resources of Montana by providing MFWP wildlife staff with science-based, quantitative data to ensure sound and responsible management of moose on a statewide basis.

This grant will also provide benefit to Montana's hunters and wildlife-viewers. Enhanced management of Montana's moose populations should result in increased harvest rates by hunters, decreased days hunting per kill, and increased hunter satisfaction. Additionally, enhanced management of Montana's moose populations should also result in increased sightings and satisfaction by wildlife-viewers. This grant will also benefit local economies as hunters and wildlife-viewers are willing to travel considerable distances to enjoy their passions.

## Approach

MFWP wildlife staff will capture 90 (N=30 each per three study areas) adult female moose using helicopter darting to immobilize individuals with carfentanil (0.01 mg/kg or 3-6 mg/adult; Arnemo et al. 2003). Carfentanil will be reversed with naltrexone at 100 mg/mg of carfentanil and administered intramuscularly. Animals will be kept in sternal recumbency with head higher than the body when possible to avoid rumen regurgitation and aspiration (Kreeger 2000). Baseline temperature, pulse, and respiratory rate (TPR) values will be recorded following the procedures described by Franzmann et al. (1984).

Female moose will be fitted with either very high frequency (VHF, Model LMRT-4) or global positioning system (GPS, Model LifeCycle) radio telemetry collars (Lotek Wireless, Newmarket, Ontario) with mortality sensors.

MFWP wildlife staff will collect blood, fecal, and hair samples from all captured moose (N = 30 per study area). Additionally, lower canine (the outermost tooth on incisor bar) will be collected for aging of individuals that are older than 1.5 years (Swift et al. 2002, Mansfield et al. 2006). Staff will use a combination of estimated total body fat (estimated using rump fat thickness measured with ultrasonography according to Stephenson et al. 1998) and body condition scoring to estimate the nutritional condition of captured individuals (Cook et al. 2010). Live body weights are logistically difficult to record for moose given their size and weights, thus staff will record total body length, chest girth, head length, hind foot length, and shoulder height to estimate body weight (Wallin et al. 1996, Franzmann 2007). Staff will use line transect sampling on two body areas to estimate winter tick loads of captured individuals (Sine et al. 2009).

Wildlife staff will use fixed- and rotary-wing aircraft and ground personnel to locate and visually assess presence of calves-at-heel of radio-collared moose. Flights will be conducted weekly during the calving seasons (May 15 – June 15) to best estimate parturition rates. We will then monitor survival of calves using visual detection from flights conducted 30-days post birth, 60-days post birth, and during late fall, mid-winter, and late-winter. Telemetry data will include spatial coordinates and their estimated accuracy, animal alive/dead status, and the presence/absence of calves-at-heel for monitoring survival of unmarked calves (Lukacs et al. 2004, Bonenfant et al. 2005). While the monitoring interval will not be sufficient to estimate cause-specific mortality, we will investigate all mortality sites and opportunistically record data concerning animal body condition, parasite loads, tissue pathology, predator evidence, and other site description data as possible. At regular intervals during the winter and summer seasons, individuals will be located using ground telemetry and closely observed to facilitate collection of fecal samples from known individuals for diet and pregnancy analyses.

Staff will also use voluntary participation by moose hunters to facilitate collection of samples for the study of nutritional condition and parasite loads. All moose hunting permit holders will be sent a mailing including a description of this study and solicitation/instructions for voluntary provision of tissue and teeth samples, rump fat measurements, and where possible whole head and liver samples.

Weather conditions within and among study areas will be recorded using temperature data loggers (N=100; Thermochron iButtons, DS1921G-F5; Dallas Maxim Corporation, Dallas, Texas; Lowe et al. 2010) placed along elevational transects within each study area. Staff will also monitor snow conditions along moose snow-tracks, including both snow depth and sinking depth. Lastly, these field data will be calibrated and supplemented with remote sensing and weather station-based models of temperature and snow conditions within each study area.

Blood samples collected in serum separation tubes will be centrifuged immediately after capture to isolate serum for pregnancy-specific protein B analysis (PSPB; Berger et al. 1999, Duquette et al. 2012). For calibration with PSPB-determined pregnancy rates, fecal progesterone will also be assessed for captured animals (Cain et al. 2012). This paired analysis will facilitate the subsequent use of fecal progesterone to monitor pregnancy collared animals not captured during subsequent years. Other whole blood (Murray et al. 2012) or blood sera (Keech et al. 1998) analyses may be conducted to characterize body condition and physiological functioning for comparison with body fat and parasite load data. Blood sera will also be used to assess exposure of moose to viruses and bacterial diseases such as epizootic hemorrhage, parainfluenza-3, and *Brucella abortus* (Ramsey 2011). Opportunistically collected heads and whole livers of moose will also be screened for meningeal worm, arterial worm, chronic wasting disease, and liver flukes (Henningson et al. 2012) at the MFWP Wildlife Laboratory (Ramsey 2011). Teeth collected from captured research animals as well as from hunter-killed animals will be sent to Matson's Lab (Milltown, Montana) for cementum aging.

Survival monitoring will consist of a varying sample of individuals monitored using animals collared during the previous year as well as additional animals collared during the upcoming year. Thus, staff will use Pollock et al. (1989) staggered-entry modification of Kaplan and Meier's (1958) product-limit survival estimator to estimate annual or seasonal adult survival rates within and among study areas. Analysis of calf survival will include a mark-recapture framework to account for imperfect probability of detecting unmarked calves-at-heel when monitoring their survival via collared adults (Lukacs et al. 2004).

Hunter sighting data will be used to estimate basic observation rates and age composition ratios as used previously for monitoring moose throughout Montana. Additionally, staff will develop a statewide moose occupancy model using a new 2013 data set of statewide moose sightings by deer and elk hunters. This approach will generally follow the methods of Rich et al. (2013) that has been previously applied to hunter sighting data for wolves in Montana. This includes treating different weeks of hunting seasons as replicate survey periods which facilitates separate

estimation of both occupancy and detection rates. Hunter effort in days is also measured during phone surveys and will be combined with other spatial data as covariates of spatial variability in the probability of detection.

(NOTE: TRACS activity tags for reporting purposes).

TRACS Activity Tag 1: Fish and wildlife population analysis

TRACS Activity Tag 2 (optional): Movement

TRACS Activity Tag 2 (optional): Food habitats

TRACS Activity Tag 2 (optional): Reproduction

**Useful Life**

No capital improvements over \$10,000 will result from this project.

**Geographic Location**

The fieldwork for this grant will take place in three different study areas encompassing portions of Beaverhead, Lewis and Clark, Liberty, Lincoln, Pondera, Teton, and Toole counties (Figure 1):

- (1) Cabinet Mountains – located in northwest Montana.
- (2) Big Hole Valley – located in southwest Montana.
- (3) Rocky Mountain Front – located in northern Montana.

**Principal Investigator(s), for Research Projects**

The federal aid coordinator and principal investigators are listed below.

Adam Brooks (MFWP Federal Aid Program Manager)	406-444-3032
Caryn Dearing (MFWP Operations Bureau Chief)	406-444-3677
Dr. Nicholas DeCesare (MFWP Research Wildlife Biologist)	406-370-3403
Justin Gude (MFWP Research and Technical Bureau Chief)	406-444-3637

**Program Income**

None.

**Budget Narrative**

Federal Share:	\$ 438,000 (75%) – Wildlife Restoration program (subprogram 5222)
State Share:	\$ 146,000 (25%) – MFWP restricted fund
<b>Total Project:</b>	<b>\$ 584,000</b>

NOTE: Applicants may provide the budget information using the SF 424A (Budget Information for Non-Construction Programs), SF 424C (Budget Information for Construction Programs), or using the applicant's created budget displaying an equivalent or greater level of detail.

Budget Category	Cost
Personnel	\$355,000
Fringe Benefits	\$84,000
Travel	\$19,500
Equipment	\$43,500
Supplies	\$9,000
Contractual	\$20,320
Construction	\$ 0
Total Direct Costs	\$531,320
Indirect Costs	\$52,680
<b>TOTAL</b>	<b>\$ 584,000</b>

Personnel - budget estimate comprised of staff (4-8) in the following classifications: (1) Research Wildlife Biologist; (2) Wildlife Technician; (3)

Research and Technical Bureau Chief; and (4) Operations Bureau Chief.

Fringe Benefits - comprised of the required employer contribution of Social Security, Medicare, unemployment tax, retirement, and employee health insurance, and is estimated at 23.66% of salaries.

Travel - staff will attend in-state meetings related to moose management/issues and to disseminate results of this project as necessary. Staff may also attend regional/national professional meetings (i.e. The Wildlife Society) to disseminate findings/results. Travel costs will include lodging, transportation, and per diem following state policies and procedures.

Equipment - the following equipment is necessary and reasonable for the accomplishment of grant objectives.

- One Dodge Ram ¾ ton truck - \$30,000. Useful life = 6 years.
- 63"W x 60"H utility trailer (6,000 lb. GVWR) - \$5,000. Useful life = 6 years.
- ATV (Kawasaki Brute Force 750 4x4i) - \$8,500. Useful life = 5 years.

Supplies - budget estimate includes general office/lab supplies, field sampling gear, consumables (batteries, storage envelopes, vials, flashlights), field sampling supplies (tape, zip ties, gloves, storage bags/bins, tools, rope/straps, GPS receivers, temperature data loggers).

Contractual - budget estimate for master agreement contract with private, third-party helicopter company used for aerial dart sampling events of adult female moose.

Indirect Costs - MFWP approved negotiated indirect cost rate agreement is 12% charged to the base of salaries and fringe. A copy of the NICRA is on file in the WSFR Region 6 Office.

In-Kind Match: No in-kind match will be utilized for this grant.

Pre-Award Costs: No pre-award costs are requested for this grant.

Indirect Cost Statement: We are (1) a U.S. state government entity receiving more than \$35 million in direct Federal funding each year with an indirect cost rate of 12.00%. We submit our indirect cost rate proposals to our cognizant agency. A copy of our most recently approved rate agreement/certification is on file in the WSFR Region 6 Office.

Single Audit Reporting Statement: The state of Montana was required to submit a Single Audit report for the its most recently closed fiscal year and that report is available on the Federal Audit Clearinghouse Single Audit Database website. The report is filed under the state of Montana's EIN (99-9999999).

Conflict of Interest Statement: MFWP, at the time of this application, is not aware of any actual or potential conflicts of interest that may arise during the life of this award which may affect the MFWP, its employees, or its subrecipients. Should an actual or potential conflict of interest arise during the period of performance, then MFWP will notify the WSFR Regional Office.

## **Multipurpose Projects**

None.

## **Relationship with Other Grants**

This project builds upon previous MFWP Wildlife Restoration moose research grants F14AFXXX3 and F12AFXXX1.

## **Timeline**

Period of performance is July 1, 2016 - June 30, 2021.

### **Animal Capture and Handling**

- Capture and collaring of adult female moose - Winter months.

### **Animal and Field Site Monitoring**

- Aerial and ground monitoring of radio-collared moose - summer months.
- Calf survival monitoring 30 and 60 days post-birth, late fall, mid-winter and late winter.
- Mortality monitoring - Periodically as mortality events occur throughout the year.
- Fecal sample collection - Regular intervals during summer and winter months.

### **Lab Analysis**

- Blood sample collection and analysis - Following capture activities in winter months.
- Disease screening for CWD, meningeal worm, arterial worm and liver flukes - Opportunistically
- Teeth collection for cementum aging - Fall and winter months.

## **General**

**NOTE: 50 CFR 80.82 (c) requires that a project statement must include information pertaining to 13 data elements. Element 13 requires that information be included in the project statement that (a) shows that the proposed activities are eligible for funding and substantial in character and design and (b) enables the Service to comply with applicable requirements under NEPA, ESA, and NHPA, and other laws, regulations, and policies. If information is not provided in the project statement, please attach additional documentation regarding NEPA, ESA, and NHPA compliance.**

## **Literature Cited**

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## Related Pages

[Wildlife Restoration Program](#)

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## Resources

[Project Statement\\_Moose Research.docx](#)

[WSFR\\_Quick Reference\\_WR](#)

[Wildlife Restoration Funding Diagram](#)

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## References

[50 CFR 80.50 What activities are eligible for funding under the Pittman-Robertson Wildlife Restoration Act?](#)

[50 CFR 80.82 What must an agency submit when applying for a project-by-project grant?](#)